

COMPLETE LISTING OF THE CLAIMS

The following lists all of the claims that are or were in the above-identified patent application. The status identifiers respectively provided in parentheses following the claim numbers indicate the current statuses of the claims.

1. (Currently Amended) An interconnect system comprising:

a first circuit unit integrated on a first chip containing a first electronic circuit and a plurality of modulators, wherein:

the first electronic circuit produces a plurality of electrical output signals;

and

each modulator is controlled by a corresponding one of the electrical output signals and is capable of modulating a corresponding component of a first optical signal output from the first circuit unit; and

a second circuit unit integrated on a second chip containing a second electronic circuit and a plurality of detectors, wherein:

the second electronic circuit processes a plurality of electrical input signals;

and

each detector is capable of detecting modulation of a corresponding one of the components of the first optical signal to extract a corresponding one of the input signals.

2. (Previously Presented) The system of claim 1, wherein:

the second circuit unit further comprises a second plurality of modulators, wherein each modulator in the second circuit unit is capable of modulating a corresponding component of a second optical signal; and

the first circuit unit further comprises a second plurality of detectors, wherein each detector in the first circuit unit is capable of detecting modulation of a corresponding one of the components of the second optical signal to extract a corresponding electrical signal.

3. (Currently Amended) ~~The~~ An interconnect system of claim 1, wherein the comprising:

a first circuit unit further comprises: containing a first electronic circuit, a photonic bandgap crystal, and a plurality of modulators, wherein:

the first electronic circuit produces a plurality of electrical output signals;

and

each of the modulators is controlled by a corresponding one of the electrical output signals, is capable of modulating a corresponding component of a first optical signal output from the first circuit unit, and comprises a defect within the photonic bandgap crystal and an electrode adjacent to the defect, wherein the defect acts as a resonator for the corresponding component of the first optical signal and has an optical property that varies with a voltage applied to the electrode; and
a second circuit unit containing a second electronic circuit and a plurality of detectors, wherein:

the second electronic circuit processes a plurality of electrical input signals;
and

each detector is capable of detecting modulation of a corresponding one of the components of the first optical signal to extract a corresponding one of the input signals.

4. (Currently Amended) ~~The~~ An interconnect system of claim 1 comprising:
a first circuit unit containing a first electronic circuit and a plurality of modulators,
wherein:

the first electronic circuit produces a plurality of electrical output signals;
and

each modulator is controlled by a corresponding one of the electrical output signals and is capable of modulating a corresponding component of a first optical signal output from the first circuit unit; and
a second circuit unit containing a second electronic circuit and a plurality of detectors, wherein:

the second electronic circuit processes a plurality of electrical input signals;
and

each of the detectors comprises a photodiode at a corresponding defect within a photonic bandgap crystal, wherein the defect acts as a resonator for the corresponding component of the first optical signal, and the detector is capable of detecting modulation of a corresponding one of the components of the first optical signal to extract a corresponding one of the input signals.

5. (Canceled)

6. (Currently Amended) The interconnect system of ~~claim 5~~ claim 1, further comprising a first light source that is external to the first chip and provides the first optical signal to the first circuit unit.

Claims 7 to 16 (Canceled)

17. (Previously Presented) An interface for input/output to/from an electronic integrated circuit, comprising:

- a photonic bandgap crystal;

- a line defect in the photonic bandgap crystal;

- a first plurality of point defects within the photonic bandgap crystal, wherein each of the point defects acts as a resonator for a different wavelength of light in the line defect;

- a plurality of electrical elements respectively adjacent to the first plurality of point defects, wherein the electrical elements produce electrical input signals of the electronic integrated circuit from respective optical signals having the wavelengths resonant with the adjacent point defects;

- a second plurality of point defects that respectively act as resonators for a plurality of different wavelengths of light; and

- a plurality of modulators respectively adjacent to the second plurality of point defects, wherein the modulators respectively respond to electrical output signals of the electronic integrated circuit to modulate optical signals respectively having the wavelengths that are resonant with the adjacent point defects.

18. (Previously Presented) The interface of claim 17, wherein the modulators comprise a plurality of electrodes respectively adjacent to the second plurality of the point defects, wherein each of the point defects in the second plurality has an optical property that varies with a voltage applied to the adjacent electrode.

19. (Previously Presented) The interface of claim 17, wherein each of the electrical elements comprises a photodiode within the adjacent point defect.

Claims 20 to 39 (Canceled)

40. (Previously Presented) The interface of claim 17, wherein each of the point defects acts as a drop filter for a different frequency of light.

41. (Previously Presented) The system of claim 3, wherein the first circuit unit further comprises a line defect that acts as a waveguide for the first optical signal in the photonic bandgap crystal, wherein each of the defects in the modulators is adjacent to the line defect.

42. (Previously Presented) The system of claim 41, wherein each of the defects in the modulators comprises a point defect.

43. (Canceled)

44. (Currently Amended) The system of ~~claim 1~~ claim 3, wherein ~~the first circuit unit further comprises:~~

~~a photonic bandgap crystal containing a plurality of defects, wherein each of the defects acts as a resonator for a different one of the components of the first optical signal, and~~ a material in each of the defects has a refractive index that depends on an electric field in the material; and

~~a plurality of electrodes respectively adjacent to the plurality of defects, wherein~~ the electronic output signals are respectively applied to the electrodes to change the electric fields in the respective defects.

45. (Currently Amended) The ~~modulator system~~ system of claim 44, wherein the material in the point defect comprises lithium niobate.

46. (Currently Amended) ~~The~~ An interconnect system of claim 1 comprising:
a first circuit unit containing a first electronic circuit and a plurality of modulators,
wherein:

the first circuit unit produces a plurality of electrical output signals and
comprises: a first waveguide for input of light that includes a plurality of frequency components; a plurality of drop filters positioned to respectively extract and separate the plurality of frequency components from the first waveguide, wherein the plurality of modulators are respectively associated with the plurality of drop filters, each modulator being capable of modulating the frequency component extracted by the drop filter associated with the modulator; and a second waveguide into which the frequency components from the modulators are directed; and

wherein

each modulator is controlled by a corresponding one of the electrical output signals and is capable of modulating a corresponding component of a first optical signal output from the first circuit unit; and

a second circuit unit containing a second electronic circuit and a plurality of detectors, wherein: the second electronic circuit processes a plurality of electrical input signals; and each detector is capable of detecting modulation of a corresponding one of the components of the first optical signal to extract a corresponding one of the input signals.

47. (Canceled)

48. (Currently Amended) ~~The~~ An interconnect system of claim 1 comprising:
a first circuit unit containing a first electronic circuit and a plurality of modulators,

wherein:

the first electronic circuit produces a plurality of electrical output signals;
and

each modulator is controlled by a corresponding one of the electrical output signals and is capable of modulating a corresponding component of a first optical signal output from the first circuit unit; and

a ~~the~~ second circuit unit ~~further comprises~~ containing a second electronic circuit, a plurality of detectors, and a photonic bandgap crystal containing a plurality of defects,
wherein:

the second electronic circuit processes a plurality of electrical input signals;
each of the defects acts as a drop filter for a different wavelength of light; and
the plurality of detectors are respectively associated with the plurality of defects,
wherein each detector is capable of detecting modulation of a corresponding one of the components of the first optical signal to extract a corresponding one of the input signals by
generating ~~generates~~ an electrical signal that indicates a modulation of a light signal
extracted by the associated defect.

49. (Currently Amended) ~~The~~ An interconnect system of claim 1 comprising:
a first circuit unit containing a first electronic circuit and a plurality of modulators,

wherein:

the first electronic circuit produces a plurality of electrical output signals;
and

each modulator is controlled by a corresponding one of the electrical output signals and is capable of modulating a corresponding component of a first optical signal output from the first circuit unit; and
a second circuit unit containing a second electronic circuit and a plurality of detectors, wherein;

the second circuit processes a plurality of electrical input signals and comprises: a waveguide for the first optical signal; and a plurality of drop filters positioned to respectively extract the components of the first optical signal from the waveguide, wherein the plurality of detectors are respectively associated with the plurality of drop filters, each detector being capable of detecting modulation of the component corresponding to the drop filter associated with the detector to extract from the first optical signal a corresponding one of the input signals.

50. (Canceled)

51. (Currently Amended) An ~~interface of an electronic~~ integrated circuit, comprising:

an circuit capable of processing a plurality of electrical signals; and
a waveguide for an optical signal that includes a plurality of frequency components respectively corresponding to the plurality of electrical signals;

a plurality of resonators adjacent to the waveguide, wherein the resonators respectively correspond to the frequency components, and each of the resonators provides a path for the corresponding frequency component; and

a plurality of electrical elements respectively associated with the resonators, wherein the plurality of electrical elements respectively implement transformations between the ~~plurality of~~ frequency components and ~~a plurality of the respective~~ electrical signals of the ~~electronic integrated~~ circuit.

52. (Currently Amended) The ~~interface~~ integrated circuit of claim 51, further comprising a photonic bandgap crystal.

53. (Currently Amended) The ~~interface~~ integrated circuit of claim 52, wherein the waveguide comprises a defect in the photonic bandgap crystal.

54. (Currently Amended) The ~~interface~~ integrated circuit of claim 52, wherein

each of the resonators comprises a defect in the photonic bandgap crystal.

55. (Currently Amended) The ~~interface~~ integrated circuit of claim 51, wherein each of the resonators comprises a drop filter that extracts the corresponding frequency component from the optical signal in the waveguide.

56. (Currently Amended) The ~~interface~~ integrated circuit of claim 55, wherein each of the electronic elements comprises a photodetector that generates a corresponding one of the electrical signals from the frequency component extracted by the resonator.

57. (Currently Amended) The ~~interface~~ integrated circuit of claim 51, wherein each of the resonators feeds the corresponding frequency component into the waveguide.

58. (Currently Amended) The ~~interface~~ integrated circuit of claim 57, wherein each of the electronic elements comprises a modulator that is controlled by a corresponding one of the electrical signals and modulates the frequency component that the associated resonator feeds into the waveguide.

59. (Canceled)

60. (Currently Amended) The system of claim 1, wherein ~~the first circuit unit is in a first chip; the second circuit unit is in a second chip; and the first chip and the second chip are mounted on a substrate for transmission of the first optical signal between the first and second chip chips.~~

61. (Previously Presented) The system of claim 60, further comprising a source of light in the first optical signal wherein the source is mounted on the substrate.

62. (Currently Amended) The ~~An interconnect system of claim 1~~ comprising:
a first circuit unit containing a first electronic circuit and a plurality of modulators,
wherein:

the first electronic circuit produces a plurality of electrical output signals;

and

each modulator is controlled by a corresponding one of the electrical output signals and is capable of modulating a corresponding component of a first optical

signal output from the first circuit unit; and
a second circuit unit containing a second electronic circuit and a plurality of
detectors, wherein:

the second electronic circuit processes a plurality of electrical input signals;
and

each detector is capable of detecting modulation of a corresponding one of
the components of the first optical signal to extract a corresponding one of the
input signals, wherein

the first and second circuit units are integrated in a chip, and the first optical signal propagates from the first circuit unit to the second circuit unit within the chip.